MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2017/2018

EEL3156 – RENEWABLE ENERGY TECHNOLOGY

(LE)

16 MARCH 2018
3.00 p.m. – 5.00 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 4 pages with 5 Questions only.

2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

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Question 1

(a) List five primary sources of renewable energy. [5 marks]

(b) Sketch diagrams to show the contrast between renewable and finite energy supplies. Also label the environmental energy flow and harnessed energy flow in your diagrams. [6 marks]

(c) In 2015, a population of 700 people lives in an area of 2.8 km^2 is supplied with electricity by renewable energy source from a solar farm. The average energy flux from renewable sources is 500 W per square meter and the efficiency of generated power from solar farm is 5%. If the average per capita energy usage is 2 kW, calculate

(i) the total power required to supply that population after 10 years if the population is increased by 15%, and [3 marks]
(ii) the percentage of land area required to generate the power in (i). [6 marks]

Question 2

(a) What are the required data for the flow rate measurement and state the reason? List all the methods available to measure the flow rate. [9 marks]

(b) A propeller turbine with 75% efficiency has shape number $\zeta = 4$ produces 120 kW output power at a working head of 8 m. Calculate

(i) the flow rate, and [7 marks]
(ii) the angular speed of the shaft. [4 marks]

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Question 3

(a) Outline two main differences between solar thermal and solar PV technology. [4 marks]

(b) A $2m \times 3m$ flat plate collector has a loss resistance of R_L=$0.2m^2KW^{-1}$ and a plate transfer efficiency of η_{pf} = 0.9. The glass cover has transmittance of τ =0.85 and the absorptance of the plate is α=0.8. The ambient temperature is taken as T_a=$25^{\circ}C$ and the irradiance on the plane of the collector G=$800Wm^{-2}$. Assuming that the flat plate collector is to be replaced if its efficiency drops below 50%, determine the critical plate temperature. [10 marks]

(c) Explain the effect of "partial shading" on solar PV cells. Recommend one mitigation to the problem. [6 marks]

Question 4

(a) Bioenergy may assume the form of solid, liquid or gas. Compare solid biomass with biogas biofuel. [6 marks]

(b) Discuss on the social and environmental aspects of bioenergy. [4 marks]

(c) Figure 4(c) illustrates the profile of a typical hot dry rock system used to harness geothermal energy. The depth with minimum useful temperature is 2.5km while the maximum depth is 5km. If the geothermal temperature gradient is $50^{\circ}C/km$, compute the number of years it will take for the useful heat extraction rate to fall to $100MW/km^2$. Other parameters are ρ_r = 2800 kgm^{-3}, c_r = 800 Jkg^{-1} K^{-1} and time constant of 2.76Gs. [10 marks]

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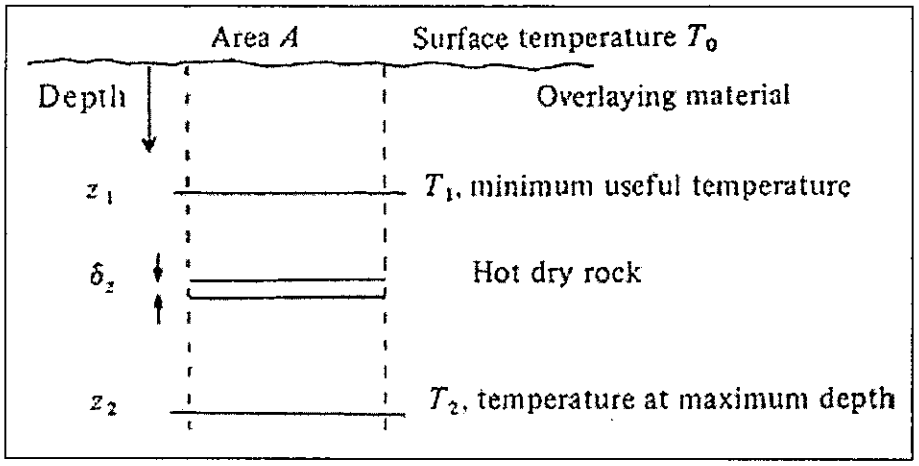

Figure 4(c)

Question 5

(a) State the main challenges to integrate power from the wind with grid connection and suggest one solution for each challenge. [6 marks]

(b) List any three methods of energy storage employed in renewable energy system and give one example for each. [6 marks]

(c) Discuss the main causes for the 'underachievement' of the lead acid battery. [8 marks]

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